Adaptive Optics Laboratory and Experimentation System

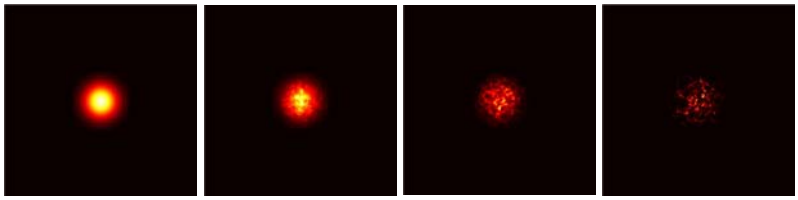
Maj Matthew Goda, Assistant Professor

Abstract:

The aim of this research is to develop a modular and easily reconfigurable atmospheric turbulence simulation methodology for laboratory verification of adaptive optics system performance. Spatial light modulators (SLMs) will be used to vary the phase on the input laser beam in a way to model atmospheric effects. This work supports the AFOSR High Energy Laser MRI and the laser warning receiver office within AFRL/SN. The Adaptive optics test and experimentation laboratory dedicated to the validation of adaptive optics concepts. To allow for system flexibility to model a range of atmospheric conditions (e.g. anisoplanatism, thermal blooming) and compensation techniques (e.g. deformable mirrors), the system is primarily composed of liquid crystal spatial light modulators to simulate atmospheric turbulence and act as surrogate optical elements. Some lower order effects can be represented with a single device, but the full system will consist of multiple SLMs, each representing a portion of the atmospheric path. In addition to the modeling of atmospheric turbulence, the use of SLMs to model wavefront reconstruction techniques (surrogate deformable mirrors) is also be investigated.

Research Methods:

This research is experimental in nature, verifying the performance of the SLMs for modeling atmospheric turbulence. The SLMs are nematic liquid crystal devices that apply a phase only distortion to the incoming beam purchase from Boulder Nonlinear Systems. They are 512 x 512 pixel device, able to model the full 2π phase change. Initial calculations show that they should be able to model the atmosphere temporally at over 50 Hz. In addition to the laboratory work, the system is being modeled within the WaveTrain wave optics code for validation and performance prediction.



Diffraction Limit | r_o = 20 cm | r_o = 5 cm | r_o = 1.3 cm

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Research interests are in the area of light propagation through the atmosphere, with an emphasis on High Energy Lasers for Directed Energy applications. Other area include imaging through atmospheric turbulence and hyperspectral imaging techniques.

Student Research Associates:

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Capt Pete Crabtree, PhD Student

Funding Sources:

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